tative routine. There is also a gain in quantitative discipline because, for example, the drill in combining weights includes the usual quantitative determination of silver as chloride and the volumetric work illustrating oxidation and reduction simplifies much of the quantitative course to follow.

A semester of this course is to be followed by quantitative analysis proper with stress on the illustration of principles.

To give this second-year course profitably the last three months of general chemistry should be devoted—in the laboratory—to the simplest possible system of qualitative analysis taught without much use of physical chemistry. I have used such a system for several years and find that it pays. The gain here is in teaching the student classification, comparison, logic, showing him a focus for the many isolated facts he had accumulated and which had begun to tire him. There is also a certain craft on the part of the teacher using this plan, for there are few first-year students not roused to enthusiasm by qualitative work. Many remain in the department for advanced courses who would otherwise have lost interest. Yet no time is wasted, for such a foundation makes possible the second-year course outlined above. The majority of every class in elementary chemistry do not go on to advanced chemistry. This plan gives them a more rounded training.

Better a genuine system than attempts to popularize the subject by unrelated tests of foods. The student has a right to a proper mental discipline even though he does not always insist upon that right.

HARRY N. HOLMES

OBERLIN COLLEGE

STYLOLITES IN QUARTZITE

TO THE EDITOR OF SCIENCE: Dr. F. L. Ransome describes and figures what he calls "Naturally Etched Quartzite" in his report on the Geology and Ore Deposits of the Breckenridge District, Colo.[1] While conducting a field course in geology from the University of Missouri in this area during the summer of 1915, the writer observed these so-called etched surfaces and interpreted them in the same way as Dr. Ransome had done, until one of the students brought in to camp a piece of the quartzite with a new structure. This was immediately recognized as a fragment of a stylolite. The writer investigated the locality at once, as he had been studying this particular structure in limestone for a number of years and was much interested in such an unusual mode of occurrence.

The locality where the stylolite was found was near where the 10,500-foot contour line crosses the small area of Dakota quartzite to the northeast of Lincoln in French Gulch. This slope is covered with masses of quartzite boulders. The study of a few specimens soon revealed the fact that the so-called etched surfaces were the exposed ends of stylolites, a type of surface the writer was very familiar with from his study of stylolites in limestone.

The very rough pitted surface produced by the stylolitic rods is well shown in Fig. 1 on plate 31 of Dr. Ransome's memoir. The depth of the depressions depends upon the length of the stylolitic columns which are rarely over one and three quarter inches in the quartzite, the majority being less than one inch (between one fourth and five eighths of an inch). When the stylolitic columns are short the pits are shallow and well rounded. Since the plane near the end of the stylolitic zone is a plane of weakness the majority of the fractures of the rock are along these planes, thus accounting for the abundance of the pitted surfaces among the quartzite boulders. The writer collected a series of specimens showing all gradations between stylolites and the so-called etched surfaces. Many specimens were collected which show the depressions still occupied by part of a stylolitic column, the fracture having occurred along the plane near the end of the columns rather than having followed the irregular line of contact of the stylolites. After the fractured surface has been exposed to the weather these ends are loosened and fall out, thus leaving the depressions. In some specimens the stylolites can be

[1] F. L. Ransome, U. S. G. S., P. P. 75, pp. 36–37, and plate 31.

seen on the side, with the ends of the same stylolitic columns forming the etched surfaces. A plane of stylolites may be continuous with one of the pitted surfaces. The sides of the depressions sometimes show the characteristic striations of the stylolitic columns.

So many examples show the absolute relationship and interdependence of the so-called etched surfaces and the stylolites that there can be no doubt that the two features are one and the same thing. Some solvent action has been exerted upon the surfaces because the areas between the depressions are well rounded in many specimens, but the major depressions are the result of the stylolites. Many specimens were found which still retained the usual coating of ferruginous clay.

W. A. Tarr

University of Missouri

THE DEFINITION OF ENERGY

To the Editor of Science: Language is an arrangement of words used to express and to convey ideas—and sometimes to conceal ideas or lack of ideas. More than twenty-one years ago, when compiling my "Mechanical Engineers' Pocket-book," I wanted some language in which to convey to students an engineer's idea of energy, and with Rankine, Weisbach and other books at my side, I finally wrote the following:

> Energy, or stored work, is the capacity for performing work. It is measured by the same unit as work, that is, in foot-pounds. It may be either *potential,* as in the case of water stored in a reservoir, capable of doing work by means of a water-wheel, or *actual,* sometimes called kinetic, which is the energy of a moving body.

In the several revisions my book has undergone since 1895 I have never found any reason to change the wording of this definition. Now I find in Professor Garver's article in Science of April 21, 1916, that this definition "conflicts with facts," leads to "logical absurdities," is "defective and misleading."

Desiring to find, for the next revision of my book, the best possible language, or form of words, in which to convey the idea commonly expressed by the word "energy," that is to get the best definition of the word, I have read Professor Garver's article with great care, and I find the following:

> We are acquainted with matter only as that which may have energy communicated to it from other matter, and which may in its turn convey energy to other matter.
>
> Energy we know only as that which in all natural phenomena is continually passing from one portion of matter to another.
>
> This latter, and later, conception of energy seems, to my mind, a long step in advance over the conception of energy as the "capacity of doing work."

From these statements we may derive the following definitions:

Matter.—That which may convey energy to other matter.

Energy.—That which is continually passing from one portion of matter to another.

Matter.—That which may convey that which to other that which.

Professor Garver also says:

> There is no more necessity for a "definition" of energy than there is for a definition of "matter." Both are known only by their characteristic phenomena; and these characteristics must serve to identify them and to differentiate them from each other.

But there is a necessity for definitions of both of these terms. The users of my book demand them. Every young student demands that a technical term in a text-book be defined in words that are less technical or more elementary than the term itself. For example, I define matter as follows:

> *Matter.*—Any substance or material that can be weighed or measured. It exists in three forms: solid, liquid and gaseous. A definite portion of matter is called a body.

The language used to convey ideas of physical phenomena to students of elementary physics should begin with the simplest and most easily understood words. For example, stone, water, air, solid, liquid, gaseous. The stone, water, air have some qualities in common. They occupy space, can be measured or weighed, and can not be put in motion except